



[Designation of Document] Specification

[Title of the Invention] RESONATOR PIECE, RESONATOR,
OSCILLATOR AND ELECTRONIC DEVICE

[Claims]

[Claim 1]

A resonator piece including:

a base portion in which a base portion electrode
portion is formed;

resonating arm portions formed so as to project from
the base portion;

groove portions including groove electrode portions
formed in front surfaces and/or back surfaces of the
resonating arm portions;

side surface electrode portions formed in side
surfaces of the resonating arm portions in which the
groove portions of the resonating arm portions are not
formed;

groove electrode-use connection electrode portions
that connect the base portion electrode portion with the
groove electrode portions; and

side surface electrode-use connection electrode
portions that connect the base portion electrode portion
with the side surface electrode portions, wherein

the width of the base portion side of openings of
the groove portions is formed narrower than the width of

other portions, with connection electrode disposition portions for disposing the groove electrode-use connection electrode portions or the side surface electrode-use connection electrode portions being formed near the narrowly formed openings of the groove portions, and

the shapes of the openings of the groove portions are formed so as to be substantially symmetrical with respect to hypothetical lines disposed along the longitudinal direction at width-direction centers of the groove portions.

[Claim 2]

The resonator piece of claim 1, wherein the resonating arm portions are plurally formed, and the shapes of the openings of the groove portions formed in the plurality of resonating arm portions are substantially the same.

[Claim 3]

The resonator piece of claim 1 or 2, wherein the width of the narrowly formed openings of the groove portions is formed narrower than the width of the openings of the groove portions of other portions by about 0.02 mm.

[Claim 4]

The resonator piece of any of claims 1 to 3, wherein

the groove portions are formed in the front surfaces and the back surfaces of the resonating arm portions, and in a case where cross sections of the each resonating arm portions are formed in a depth direction of the groove portions, the cross sections are formed in substantial "H" shapes.

[Claim 5]

The resonator piece of any of claims 1 to 4, wherein the resonator piece is formed by a crystal tuning fork resonator piece.

[Claim 6]

The resonator piece of claim 5, wherein the resonance frequency of the crystal tuning fork resonator piece is substantially 32 kHz.

[Claim 7]

A resonator in which a resonator piece is accommodated inside a package, the resonator piece including:

a base portion in which a base portion electrode portion is formed;

resonating arm portions formed so as to project from the base portion;

groove portions including groove electrode portions formed in front surfaces and/or back surfaces of the resonating arm portions;

side surface electrode portions formed in side surfaces of the resonating arm portions in which the groove portions of the resonating arm portions are not formed;

groove electrode-use connection electrode portions that connect the base portion electrode portion with the groove electrode portions; and

side surface electrode-use connection electrode portions that connect the base portion electrode portion with the side surface electrode portions, wherein

the width of the base portion side of openings of the groove portions of the resonator piece is formed narrower than the width of other portions, with connection electrode disposition portions for disposing the groove electrode-use connection electrode portions or the side surface electrode-use connection electrode portions being formed near the narrowly formed openings of the groove portions, and

the shapes of the openings of the groove portions are formed so as to be substantially symmetrical with respect to hypothetical lines disposed along the longitudinal direction at width-direction centers of the groove portions.

[Claim 8]

The resonator of claim 7, wherein the resonating arm

portions of the resonator piece are plurally formed, and the shapes of the openings of the groove portions formed in the plurality of resonating arm portions are substantially the same.

[Claim 9]

The resonator of claim 7 or 8, wherein the width of the narrowly formed openings of the groove portions of the resonator piece is formed narrower than the width of the openings of the groove portions of other portions by about 0.02 mm.

[Claim 10]

The resonator of any of claims 7 to 9, wherein the groove portions of the resonator piece are formed in the front surfaces and the back surfaces of the resonating arm portions, and in a case where cross sections of the each resonating arm portion are formed in a depth direction of the groove portions, the cross sections are formed in substantial "H" shapes.

[Claim 11]

The resonator of any of claims 7 to 10, wherein the resonator piece is formed by a crystal tuning fork resonator piece.

[Claim 12]

The resonator of claim 11, wherein the resonance frequency of the crystal tuning fork resonator piece is

substantially 32 kH.

[Claim 13]

The resonator of any of claims 7 to 12, wherein the package is formed in a box shape.

[Claim 14]

The resonator of any of claims 8 to 14, wherein the package is formed in a so-called cylinder type.

[Claim 15]

An oscillator in which a resonator piece and an integrated circuit are accommodated inside a package, the resonator piece including:

- a base portion in which a base portion electrode portion is formed;

- resonating arm portions formed so as to project from the base portion;

- groove portions including groove electrode portions formed in front surfaces and/or back surfaces of the resonating arm portions;

- side surface electrode portions formed in side surfaces of the resonating arm portions in which the groove portions of the resonating arm portions are not formed;

- groove electrode-use connection electrode portions that connect the base portion electrode portion with the groove electrode portions; and

side surface electrode-use connection electrode portions that connect the base portion electrode portion with the side surface electrode portions, wherein

the width of the base portion side of openings of the groove portions of the resonator piece is formed narrower than the width of other portions, with connection electrode disposition portions for disposing the groove electrode-use connection electrode portions or the side surface electrode-use connection electrode portions being formed near the narrowly formed openings of the groove portions, and

the shapes of the openings of the groove portions are formed so as to be substantially symmetrical with respect to hypothetical lines disposed along the longitudinal direction at width-direction centers of the groove portions.

[Claim 16]

An electronic device used to connect a resonator, in which a resonator piece is accommodated inside a package, to a control unit, with the resonator piece including:

a base portion in which a base portion electrode portion is formed;

resonating arm portions formed so as to project from the base portion;

groove portions including groove electrode portions